CHAPTER 4

EXPERIMENTAL RESULT

4.1 Introduction

This chapter mainly focuses on the results and analysis based on the methodology stages using case study of ceramic cluster in Lampang, Thailand. The first stage is the results of network analysis using UCINET social network software. The investigation has been carried out with the cluster leaders of all types of cluster members: e.g. core firms, CDA, supporting industries, and government agencies, etc. The second stage focuses on the JAD session which is divided into 4 sub-JAD sessions corresponding to four stages of software development process and knowledge management process. The scenario of Lampang ceramic fair is used to conduct JAD sessions. The third stage of the KMS design and development will demonstrate the result of system prototype based on the dynamic design framework throughout the JAD sessions. Following after the KMS implementation, the stage of "learning in action" analyzes the results by using the data from information and knowledge sharing through the use of KMS. The investigation of user satisfaction throughout the JAD session using functional test and operational test after system implementation until the ceramic fair event is over.

4.2 Identification of Network Key Players

The sample data was collected using reputation method. The recommended leaders from each type of clustering members are the starting point to select their social networks. Then, recommended person will do in the same way and may refer back. The maximum of two-level of recommended persons is enough. The data form a total of 36 samples is collected through questionnaires asking about their network and relationships. The details of the questionnaire can be seen in Appendix A.

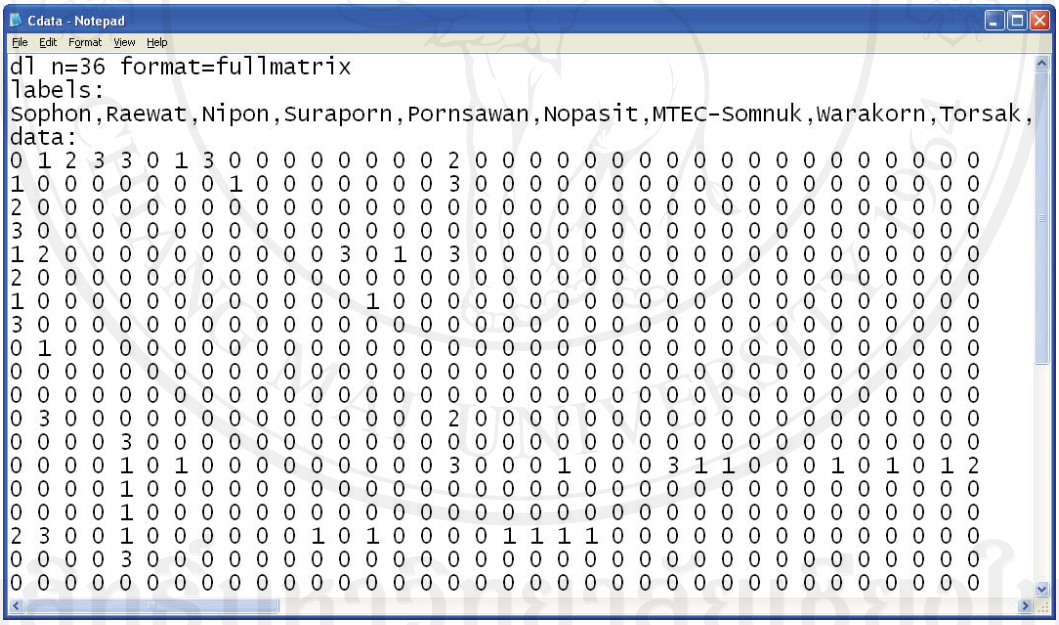

Figure 4.1 Social network matrix of Lampang ceramic cluster

Figure 4.1 is the input data in network matrix form using Notepad editor application. The measurement of degree centrality is shown in Figure 4.2 and the visualization of social network relationship is depicted in Figure 4.3. The results have shown that Mr.“Anurak” has the highest degree centrality of 16 while Mr.“Paitoon” is

the second most of 11. The “Blue” bullets in Figure 4.3 are recommend as part of the JAD team. This represents 2 core firms, 1 CDA, 1 expert, and 1 supporter covering all types of enterprises based on the cluster concept defined by Porter.

degree centrality - Notepad

File Edit Format View Help

FREEMAN'S DEGREE CENTRALITY MEASURES:

Diagonal valid? NO
Model: SYMMETRIC
Input dataset: Cdata (F:\SNA\Cdata)

		1 Degree	2 NrmDegree	3 Share
14	Anurak	16.000	45.714	0.178
17	Paitoon	11.000	31.429	0.122
1	Raewat	9.000	25.714	0.100
2	Sophon	9.000	25.714	0.100
5	Pornsawan	8.000	22.857	0.089
7	MTEC-Somnuk	3.000	8.571	0.033
3	Nipon	2.000	5.714	0.022
4	Suraporn	2.000	5.714	0.022
9	Torsak	2.000	5.714	0.022
12	Surapon	2.000	5.714	0.022
8	Warakorn	2.000	5.714	0.022
21	LIF	2.000	5.714	0.022
6	Nopasit	1.000	2.857	0.011
28	S-MRD	1.000	2.857	0.011

Figure 4.2 The degree centrality of social network of Lampang ceramic cluster

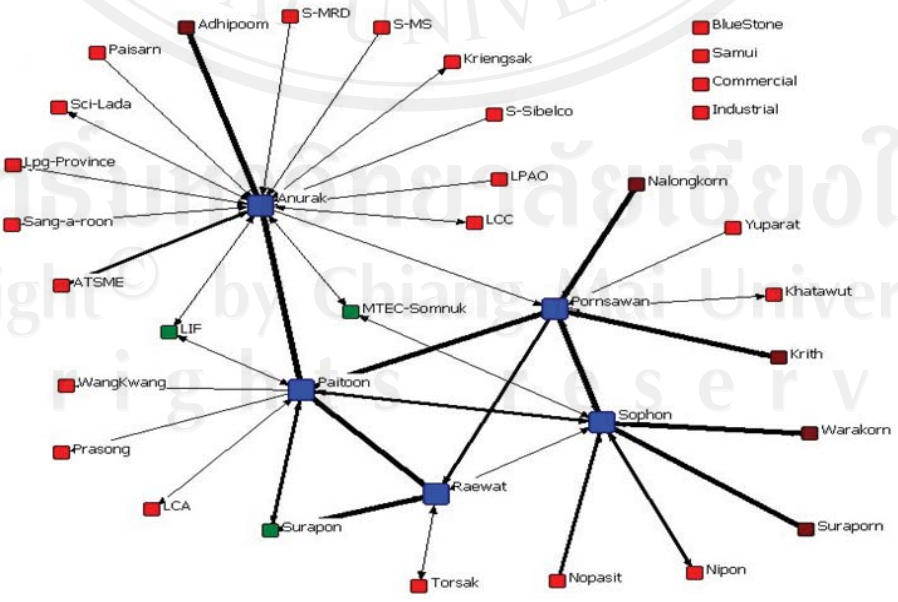

Figure 4.3 Visualization of social network relationship of Lampang ceramic cluster

4.3 Design of Workshop and Requirement Analysis

The design of workshop is to gather the JAD team in the environments for the analysis and design of the KMS. Selected cluster key players from the previous section are invited and work with the key decision maker, developer, and facilitator. Figure 4.4 is an example of JAD design workshop equipped with computerized and visualized technologies conducting the JAD #1 and #2 sessions.

Figure 4.4: JAD design workshop and JAD #1 and #2 sessions

The main objective of the JAD session is to understand and visualize the requirements and of the system. This generates the graphical view of relationships among actors and their functions for the design of the KMS. The UML use case diagram is one of the efficient tools used widely for requirement capture. To depict the scenario of business process, initial requirements are captured from cluster key players through questionnaires (See Appendix A).

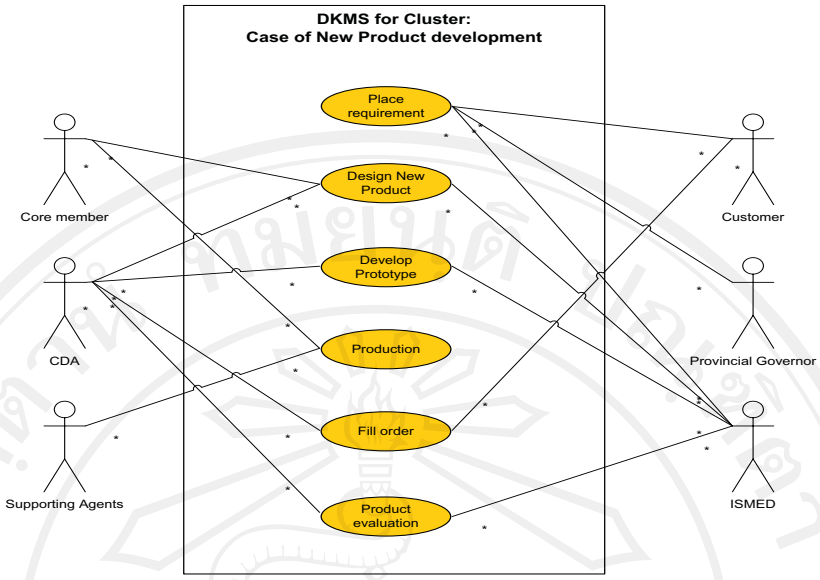

Figure 4.5: Use case diagram: scenario of new product development

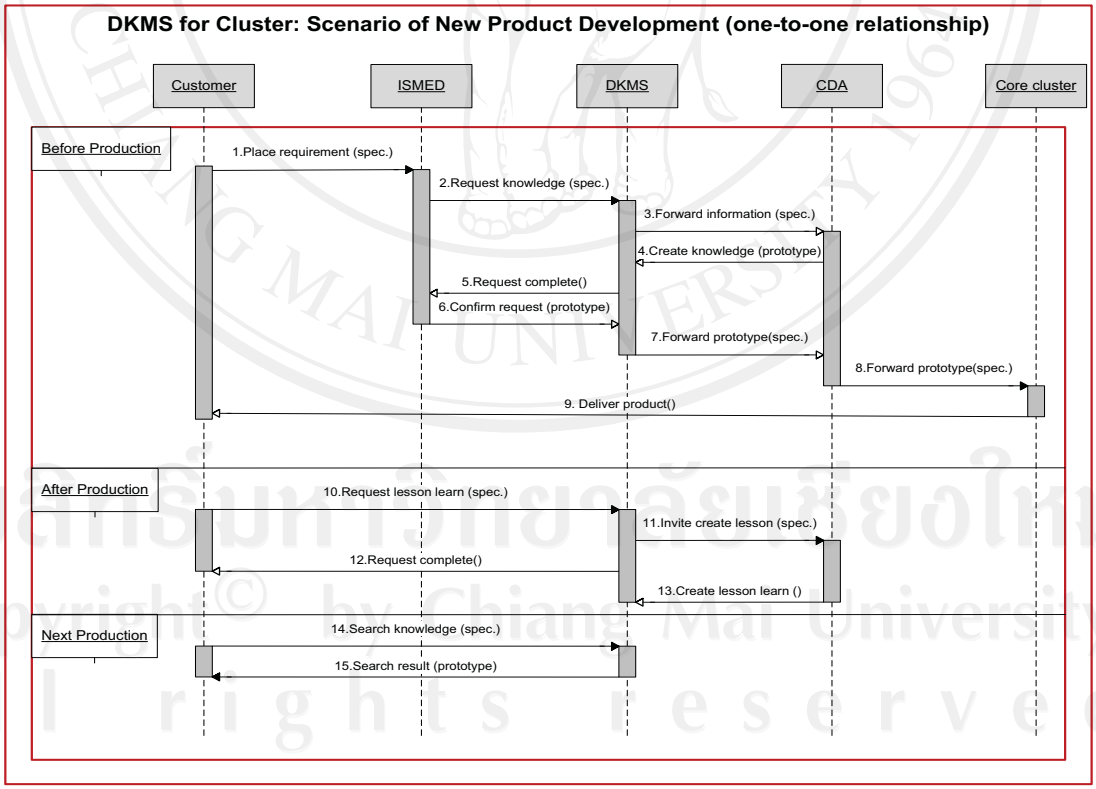

Figure 4.6: Sequence diagram: scenario of new product development

Figure 4.5 and Figure 4.6 show an example of scenario model with the UML use case diagram and sequence diagram. The use case diagram implies that there are various types of actors in the process of new product development including core members, CDA, and supporting agents (suppliers, customer, government, ISMED). The sequence diagram extends the requirement of the system in terms of interaction among the actors. It shows how the processes operate with one another and in what order. This diagram was used to model the message, information or knowledge that is exchanged from one actor to another in the system. In this research, the sequence diagram for the collaborative tasks of new product development and Lampang Ceramic Fair event are proposed. The completion of requirement specification, functional specification and test specification is shown in Appendix B.

4.4 KMS Design and Development

The prototype development of KMS is based on the dynamic design framework. The purpose of the prototype is to provide clustering members virtual space to communicate, use, share, and disseminate information and knowledge. Web 2.0 is used as the collaborative platform while SNS, discussion forums, RSS, and search tools are used to support the three dynamic aspects: response, time and events. However, for those users who rarely access the internet, push technology such as e-mail and SMS is also applied as they are basic communication tools used broadly. Information is therefore sent to all participants directly and immediately. PHP scripts are used for web development while MySQL is used to manage the relational database system. The first homepage of website gives the general view of ceramic

information for all types of people. For those clustering members who want to participate in the community network, registration process is required for the system to get username and password. However, as different types of users require different information and relate with different activities in the business process, customizing homepage can be done individually at the time they register system. Figure 4.7 compares two web pages where the background color and calendar format are different. RSS is also included in the first homepage while another does not.

Figure 4.7 Comparison between two different web pages

Figure 4.8 Social network community in the ceramic cluster

For cluster development, social networking is one of the key success factors. The system gives user the right and authority to grant or reject members engaging his or her network community. By this way, communication and knowledge sharing in community is enhanced since the information is shared based on the concept of one-to-one relationship. Figure 4.8 displays a portion of web page showing a sample social network community and information exchange among its members.

In response to the cycle of business process, the web page content for each member is changed automatically as time changes. Using CSS tools, multiple web pages can be designed and displayed automatically depending on the business process calendar each member initially selects. Figure 4.9 shows two different web pages at two different calendar periods of clustering events: the German “Ambiente Fair” and the “Lampang Ceramic Fair”.

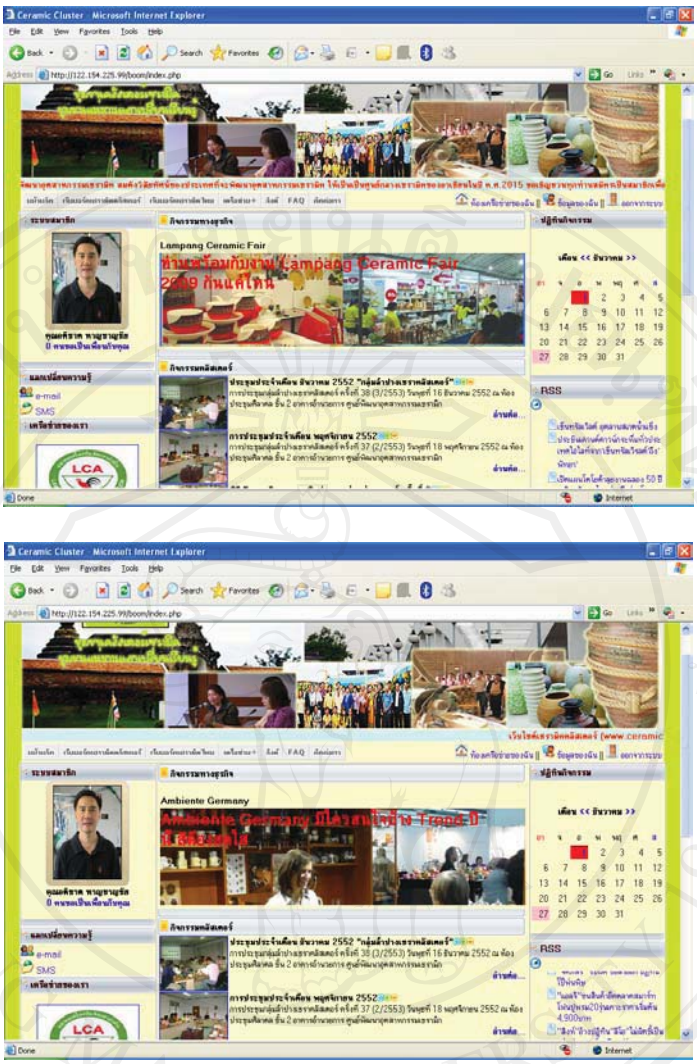

Figure 4.9 Different web pages based on different calendar events

The system also allows users to add events into the business calendar for either public or their own social network. Information activities can be updated or deleted after it has been posted. By this way, clustering members will be informed dynamically through social network sharing. Figure 4.10 is example of generating business calendar event.

Figure 4.10 Business calendar event update

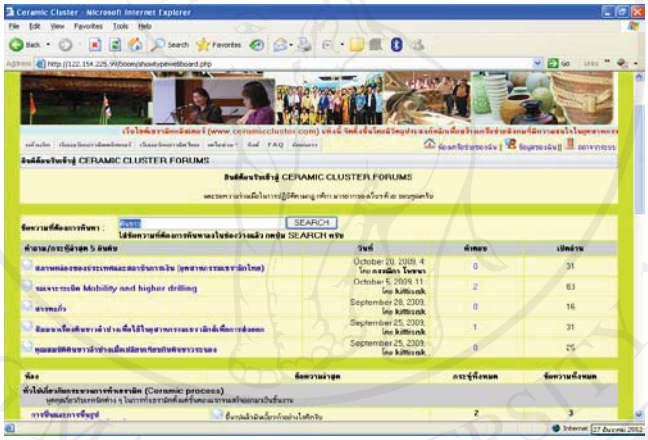

Figure 4.11 Search tool

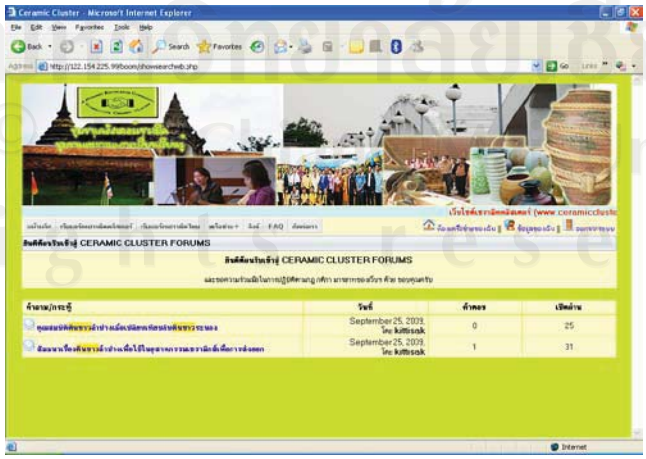

Figure 4.12 Dynamic FAQ

To acquire knowledge, the system provides search tool for users who have questions and want to get answer or information concerning their questions. By typing the key words, all posted information in web board which matches such key words will be displayed in the sequence of the most opening subjects. For the dynamic FAQ, the most opened subjects are displayed in sequence and are dynamically changed when new subjects are posted or different subjects are accessed. Figure 4.11 and Figure 4.12 show the sample of search tool and dynamic FAQ.

4.5 Learning in Action

The following steps are an example to demonstrate how clustering members learn from collaboration and knowledge sharing through the use the KMS based on the scenario of new product development:

1. Customer and provincial governor submit the product requirements
2. ISMED officer forward the requirements through e-Mail to CDA
3. CDA design the 1st draft of product specification and send to ISMED via e-Mail
4. During this process, social network discussion, e-Mail and Mobile between ISMED and CDA progress up to 4th draft before the final prototype
5. CDA submit the final prototype to the core firms for production with several discussions through e-Mail and Mobile.
6. Finished product is sent to the customer for real use
7. Some negative feedback from customers on a new bowl
8. They learn that to put chopstick on the bowl is not stable (slippery)

Figure 4.13 The 1st prototype of boat-shaped noodle bowl

Figure 4.14 The 2nd prototype of boat-shaped noodle bowl

Figure 4.15 Final prototype of boat-shaped noodle bowl

Figure 4.13 – Figure 4.16 shows the different versions of the product prototype and in practice. Figure 4.17 is an example of e-Mail between ISMED and CDA.

Figure 4.16 Final prototype of boat-shaped during practice

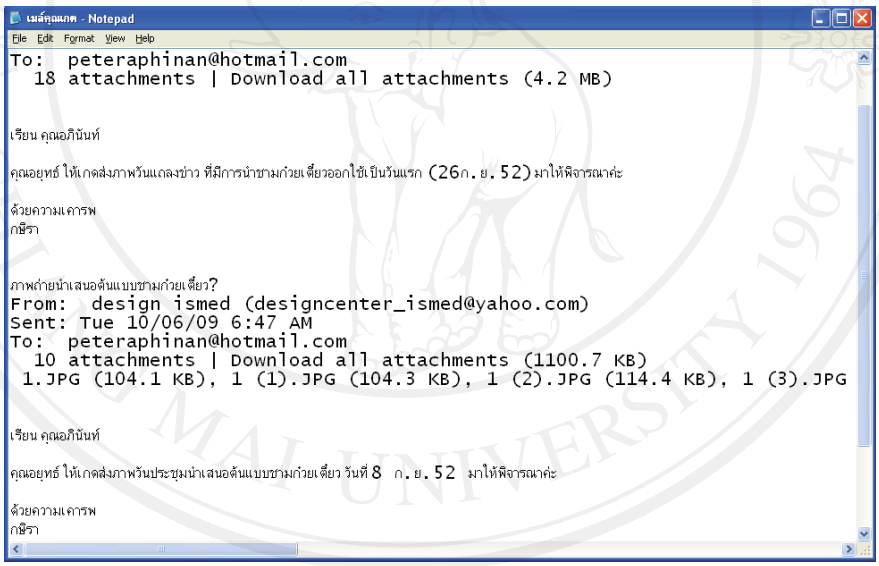

Figure 4.17 Example of e-Mail between ISMED and CDA

Therefore, new experience and knowledge they've learned from the real practice will be used for the improvement of the design of new product development in the next cycle of business process.

4.6 KMS Evaluation

To ensure the software quality, the various types of assessment and testing are to be concerned during the development process. There are many approaches to test the system. The most common tests during the stage of system development process are unit testing, integration testing, system testing, and acceptance testing (Dennis, 2005). Each test also comprises several types of tests. Unit test usually tests source code or module and combine which are the tasks of programmer and developers. This research does not focus on this part. Based on the methodology, system development is done by JAD team which requirement gathering in JAD session is the critical issue. Requirement testing is therefore essentials for testing at this stage. During the stage of learning in action using double spiral, system and acceptance testing is required to find any system risks or useful improvements. Acceptance testing can be done in two ways: alpha testing and beta testing; one of which based on made-up data and the other on real data. In this research, two types of test specifications are applied: Functional Test (FT) and Operational Test (OT). The functional test focuses on the correctness of system functions. The operational test verifies the KMS based on the scenario view.

According to the proposed ideas that the design of the KMS must be dynamic in terms of response, time and events, the functional test therefore focuses on the dynamic functions of KMS and to get feedback from the specific types of users. Three levels of user satisfaction are included: proper, fair and poor. Table 4.1 shows the main issues of functional test specification. The complete details can be found in

Appendix B. Figure 4.18 is the result of user satisfactions in the design functions of system prototype. Data is collected from the people who actively involve JAD sessions as team developers. Most of them feel in the same direction that the average score of the "proper level" of satisfaction in the issue of response, time and events are 6.6, 6.5 and 7.4 respectively from the total of 10 score.

Table 4.1 Functional test specification

Issues	Proper	Fair	Poor	Comment
FT-1 Response				
……				
FT-2 Time				
……				
FT-3 Events				
……				

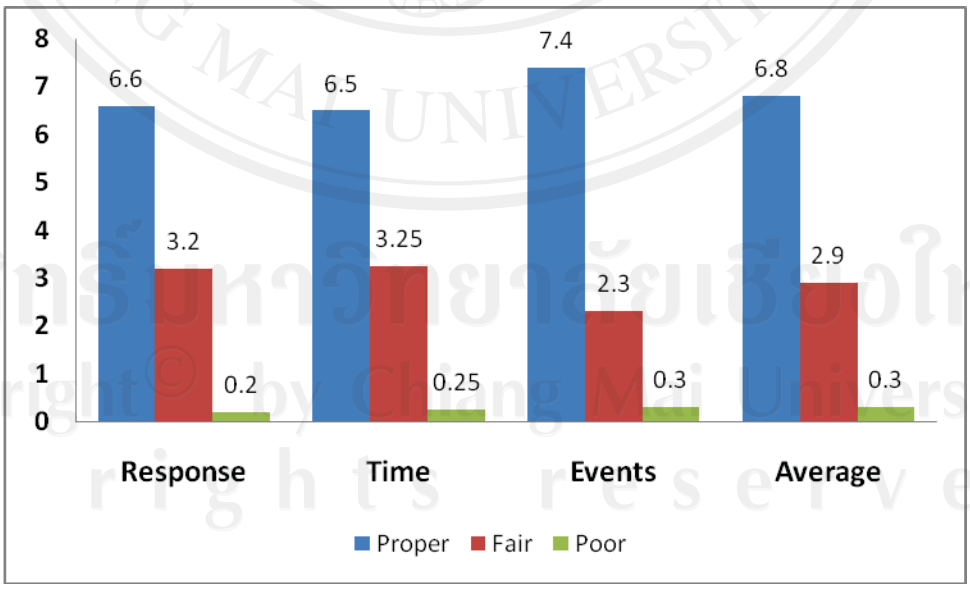

Figure 4.18 Users satisfaction in the dynamic design of prototype

Table 4.2 Operational test specification

Issues	Proper	Fair	Poor	Comment
OT-1 Before production				
…				
OT-2 After production				
…				
OT-3 Next production				
…				

In case of the operational test, the scenario of new production process as mentioned in Section 4.3 is tested. To visualize the process, the Use case diagram is used to portray the system functions based on the business process. The Use case diagram illustrates the actors (e.g. core cluster, supporters, CDA, etc.) and their actions (processes). Then, the sequence diagram extends the requirement of the system in terms of interaction among the actors. It shows how the processes operate with one another and in what order. Both diagrams will be further used for the design of system functions and operational test. Table 4.2 shows the operational test specification.

4.7 Analysis and Discussion

4.7.1 Double Spiral Process with JAD

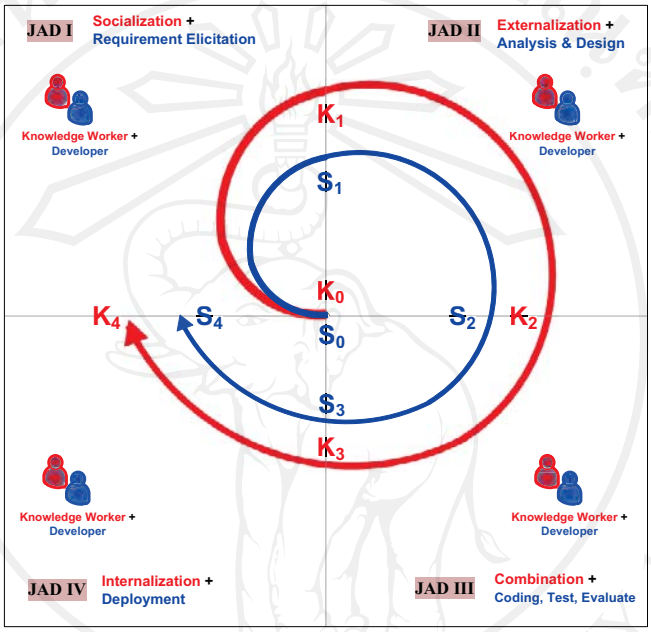

Figure 4.19 Double spiral process with JAD

According to Figure 4.19, each quadrant of the double spiral process creates the different contents of software and knowledge. In general, as the process moves to the next higher quadrant, the expansion of software and knowledge contents increase. At the end of the 4-quadrant spiral cycle, the software content ends with the 1st prototype while the knowledge content ends with new knowledge or experience learned from knowledge conversion process. Table 4.3 shows the result examples of double spiral process with JAD based on the scenario of ceramic fair of Lampang ceramic cluster.

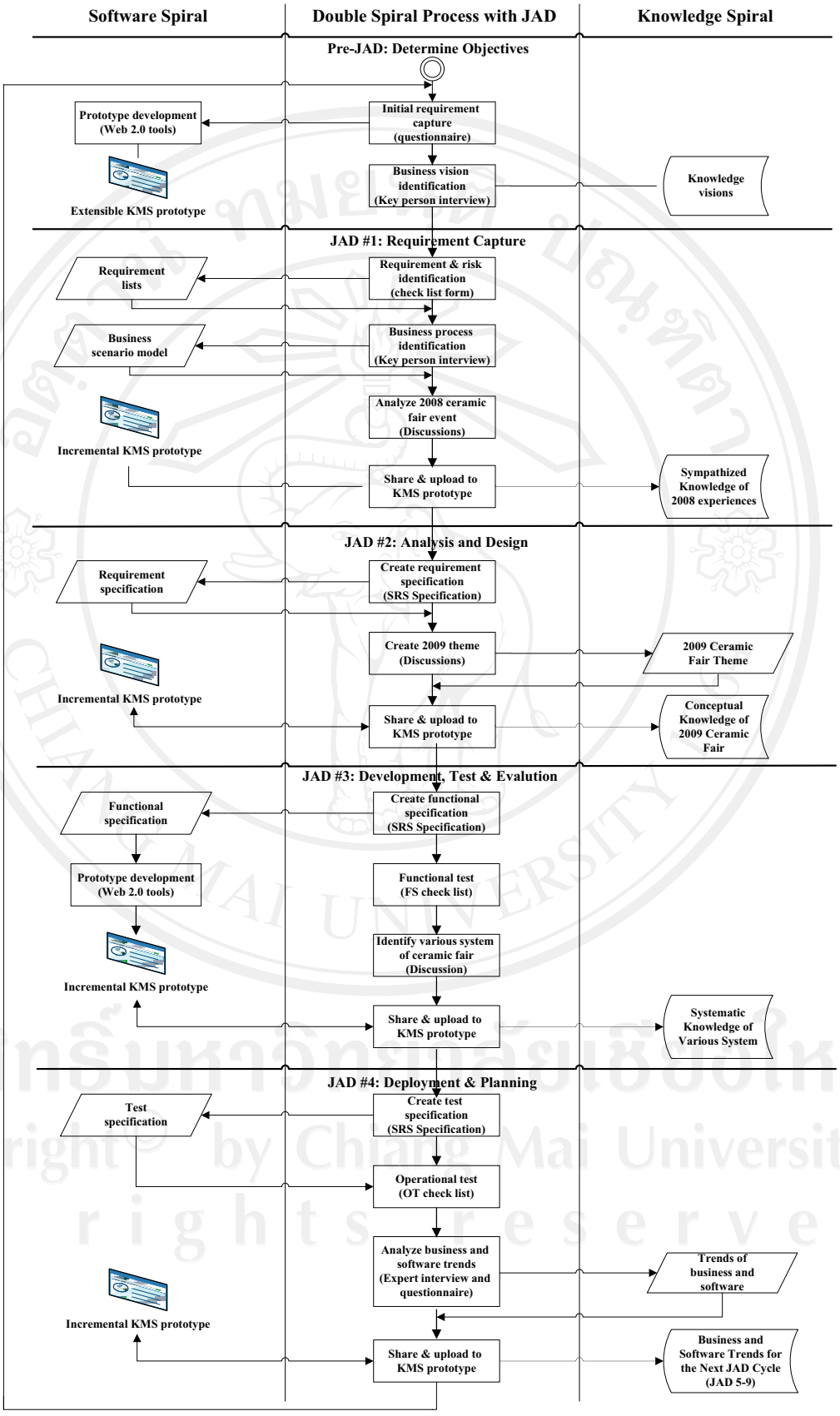

Figure 4.20 Workflow of Double Spiral Process with JAD

Figure 4.20 shows the workflow of double spiral process with JAD. The first loop of JAD session begins with JAD #1 and ends with JAD #4 representing one-year cycle of business process of the ceramic cluster. At the end of JAD session workflow, the next cycle of double spiral will repeat its process with new changes of business scenario and software technology. Therefore, it is essential to review and update technology and knowledge based on changing environments every JAD cycle. The details of software content and knowledge content are also described in Table 4.3.

The workgroup scheduled one day of effort for JAD #1. The workgroup began with an introduction to double spiral development process with JAD to familiarize all members with the roles, tools, and techniques for the four JAD sessions. The workgroup began its JAD tasks with an active review and discussion of an extensible prototype proposed by the developer. The extensible prototype and knowledge vision are based on discussions and findings during the Pre-JAD session. JAD #1 starts with requirement elicitation from the requirement check list items by all member of the workgroup. Business scenario of Lampang ceramic fair is discussed and depicted by the UML use case and sequence diagram. At the same time, the analysis of previous-year experiences are discussed in the JAD forum to come together to identify business requirements and experiential knowledge from the socialization process. Committed sympathized knowledge is then uploaded into the KMS prototype so that members will have chances to share knowledge via the web after JAD #1 ends and before JAD #2 starts.

The opening session of JAD #2 starts with the review of software function and knowledge content in the KMS. Requirement gathering from JAD #1 is transferred to requirement specification and propose to the workgroup to review. The 2009 ceramic fair is discussed to set up the event theme. Committed conceptual knowledge is then uploaded into the KMS prototype so that members will have chances to share knowledge via the web after JAD #2 ends and before JAD #3 starts. Table 4.3 shows that 2009 theme includes economic retail price, one ceramic one baht and free herb tree on ceramic pot.

JAD #3 is the development of prototype in which functional specification of the system is created. Detailed functional specification is shown in Table 4.3 in the column of software content. Test specification is also conducted (see APPENDIX B). The discussion aims at identifying various major systems for the continuation of the ceramic fair. PR management system and transportation system are examples in which details of each system are then uploaded into the KMS prototype so that members will have chances to share knowledge via the web after JAD #3 ends and before JAD #4 starts.

JAD #4 is the deployment of the system and knowledge is created through and after the ceramic fair event. The suggestion evaluation can be done in this JAD for the next revision of prototype. Business changes and software trends are discussed from software experts and knowledge experts. The next cycle of double spiral then repeats the process but concerns with different environments of business scenario and software technology.

Table 4.3: The results of double spiral process with JAD (the scenario of the 22nd Lampang ceramic fair)

JAD sessions	Software Spiral		Knowledge Spiral	
	Process	**Contents**	**process**	**Contents**
Pre-JAD	**Determine objectives:** To develop personalized web based KMS for individuals in cluster	(S_0) Extensible prototype based on the initial requirements from questionnaire (see Appendix A)	**Initial data collection:** Market survey, Expert interview, Document analysis	(K_0) **Knowledge vision** - Lampang Ceramic Fair #22 (1-10 December, 2009) Place: Municipal market 4, Lampang
JAD1	**Identify/ resolve risks & Requirement gathering:** **Risks:** Team failure, Requirements not-well understood **Resolve risks:** Informal JAD team, Early capabilities from extensible prototype	(S_1) **System scenarios:** **Use case diagram:** Cluster business process **Sequence diagram:** -Scenario of Lampang Ceramic Fair -Scenario of new product development	**Socialization:** *Social interactions* Mobile, E-mail, Social network discussions	(K_1) **Sympathized knowledge** Analysis from experiences in 2008: ***Weak points*** - Long distance for transportation - Lack of public relations - Insufficient car/ bus parking - Expensive building rent - Limited area to manage booth - Low budget from government ***Strong points*** - Appropriate time period - Many local tourists travel to North - New place of handicraft exhibition center - Car park section separated - Free transportation - Free booth for OTOP - Ceramic design contest - Many activities every day

JAD sessions	Software Spiral		Knowledge Spiral	
	process	**Contents**	**process**	**Contents**
JAD2	**Analysis & design:**	**(S2) Business vision:** Requirement specification: -See Appendix B	**Externalization:** *Online discussion* Mobile, E-mail, SMS, Social network discussions, Dynamic web board	**(K2) Conceptual knowledge** - Economic retail price - One ceramic one baht (one minute) - Profit charity to heart disease foundation - Free herb tree on ceramic pot - Coupon voucher for free ceramic - Multi-channel P/R (metro and local) - Miss ceramic contest - Car parking pass - Fair assessment research - Plus mini-motor show - Local cultural market - Food garden

JAD sessions	Software Spiral		Knowledge Spiral	
	process	**Contents**	**process**	**Contents**
JAD3	**Development, test & evaluation**	**(S_3) Functional specification:** **Dynamic in Response** Manage user: create, login, update Update background, link and font color Manage applications on webpage Manage social network: invite/ add/ delete Post blog in social network Add, delete URL: Post/ update/ delete web board Dynamic search, Dynamic FAQ **Dynamic in Time** Manage RSS Feed Webpage content updated automatically Upload/ download files Post/ Feedback in social network Feedback from posted web board **Dynamic in Events** Send e-mail, Send SMS to mobile Subscribe/ view push/pull news View/ add/ delete calendar events **Test specification:** (See Appendix B) Functional test & Operational test	**Combination:** *Using language* Mobile, E-mail, SMS, Upload/ download files, Social network discussion, Search external database	**(K_3) Systematic knowledge** - Public relations multi system - Communication system (IT-based) - Highlight marketing events - Marketing promotion system - Car parking pass system - Activities' management system - Booth management system

JAD sessions	Software Spiral		Knowledge Spiral	
	process	**Contents**	**process**	**Contents**
JAD4	**Deployment and** **Plan the next cycle of double spiral**	**(S_4) Feedback:** **Complaint:** **Requirements to change:**	**Internalization:** *Learning* -Through practice -Customers feedback	**(K_4) Operational knowledge** ***Customer knowledge:*** - Average no. of customers 10,000 per day - 2/3 of customers are woman - 30% of customers are 21-25 years of age - 55% of customers are single - 30% of customers pay 201-500 baht ***Product knowledge:*** - 75% of total sales are tableware - > 80% of sales on < 100 baht per item ***Marketing & PR knowledge:*** - 60% awareness from billboard ***Firms knowledge:*** - 30% of firms' sales 50,000-100,000 baht - Total cash sales approx. 27 M baht - Sales extension or new buyers > 3 M baht

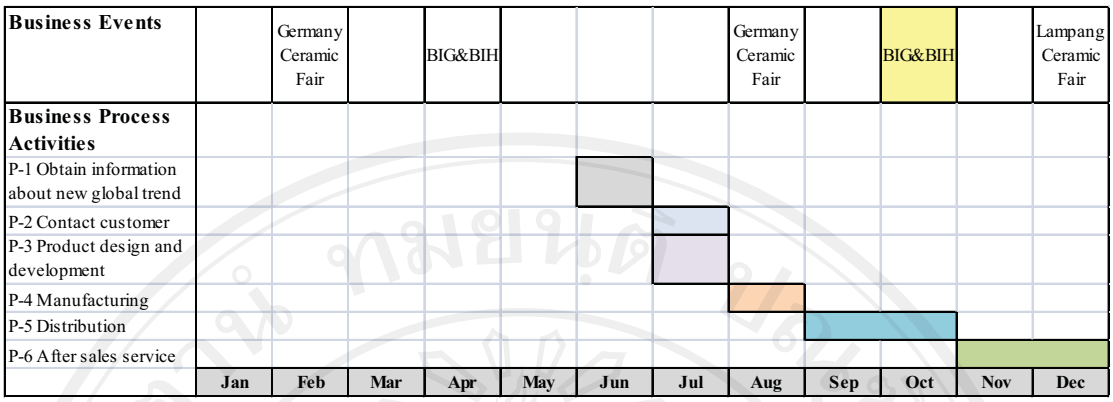

Figure 4.21 Business process cycle in ceramic cluster

The clustering firms that implement the web-based applications are mainly focus on the business strategies and business process. Figure 4.21 shows one-year cycle of business process within ceramic cluster. The Bangkok International Gift & Bangkok International Household (BIG & BIH) Fair in October is an example of business event that depicts the business process activities.

4.7.2 Types of Web-based Solutions for Business

There are many types of web-based solutions which can be classified based on the usability of companies and individuals. Each type of solution has its own design and objectives. In general, there are two important aspects in most web-based application: web content and web design. Web content affects two kinds of web sites: those with static content and those with dynamically generated content. These are also called “static web” and “dynamic web”. However, web design can be considered in the same way as web content: those with static web design and those with dynamically incremented web design. Therefore, these two factors create 4 different

categories of web based solutions for business including: brochure websites, web services, knowledge-intensive websites, and portal web as shown in Table 4.4.

Table 4.4 Four different types of web-based solutions for business

Web base types	**Web design (Presentation of the web)**	**Web content (Information of the web)**	**Examples**
Brochure websites	Static	Static	Personal web
Web services	Dynamic	Static	RSSthai.com, PTT
Knowledge-intensive websites	Static	Dynamic	Wikis, Blogs pantip.com
Portal web	Dynamic	Dynamic	Youtube.com MSN.com

The **"brochure websites"** type of business normally uses websites to provide company information one way only. This may caused by the small budget of web-based strategies or the business policy does not concern with web application as to support the company growth. Usually these websites contain a "Contact Us" with e-mail or phone contact section to allow prospective customers/ partners the opportunity to later communicate with the website owner. The design and content of web does not change much once it is implemented. Life cycle is generally unstable or is short for this type of website. The **"web services"** usually provide the same contents to other web servers with different presentations. RSSthai.com and Thailand PTT crude oil price are examples of web services. Life cycle of this type of website depends on the dynamism and quality of knowledge contents.

The **"knowledge intensive websites"** is the web that the web presentation is not a critical issue but the web content is mostly dynamic. Once the commercial and free CMS software are installed, the design will not be changed until the new version is launched. Wikipedia, web board and blogs are examples. Life cycle of this type of website depends mainly on the correctness and reliability of knowledge contents which the verification is essentially needed. Therefore, some websites are not usable while others are more competitive.

The **"portal web"** such as YouTube and MSN is the web that both web design and web content are always dynamic. Many web tools are available and often customized while the new web tools are also added. Various types of knowledge such as text, picture, video and sound are accepted. The life cycle of this type of website is mostly sustainable long which in turn business is more competitive.

The first generation of Lampang ceramic association (LCA) website ("www.ceramiclampang.com"), for example, is designed and developed internally by a member of the association with a limited budget. A few months later, not many people access or upload contents to the web while the web presentation does not change since it was launched ("static design and static content"). The 2nd of LCA website is outsourced to the professional developer for a one year project plan. The web design seems to be customized all the time but the contents is still mostly static ("dynamic design and static content"). After the board of committees requests all members to communicate and share information via the web, the web contents increase. This is then 3rd generation of the "static design but dynamic content". By

interviewing to the key persons, the major obstacles for the non-dynamism of web design and web content is as the following issues:

- The person who responsible for web development which is affected by the supporting budget

- Web application meets the requirements for all individuals

- Members will access, use and share the web in a sustainable way

Therefore, to make the web more meaningful and competitive for business, both web design and web content must be dynamic in a sustainable way.

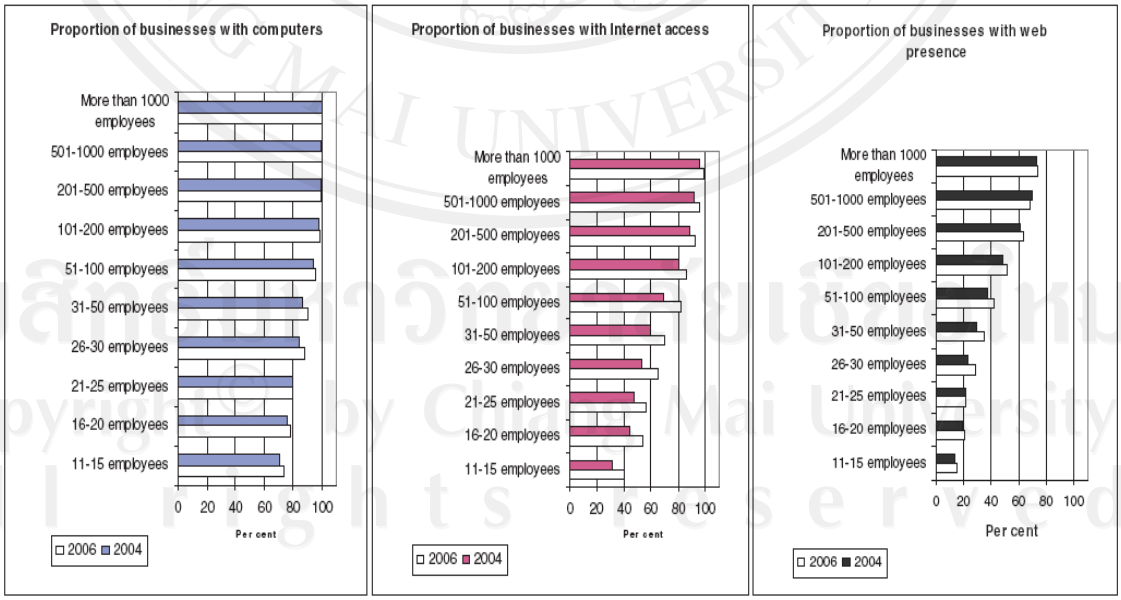

Figure 4.22 Computers, internet and web presence by size (United Nations, 2008)

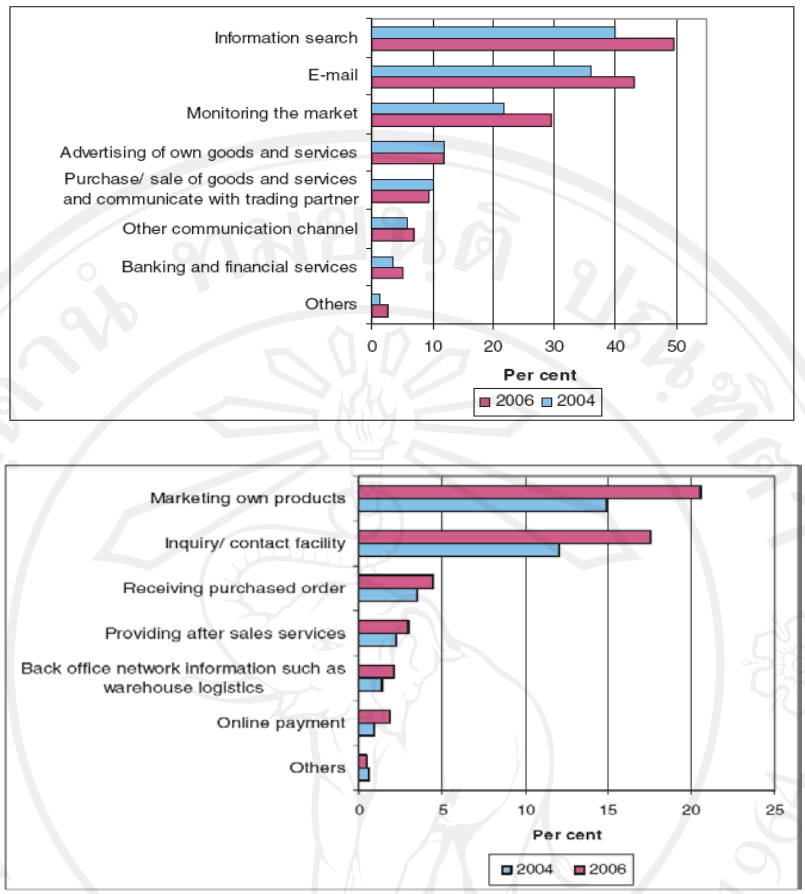

Figure 4.23 Reasons for using the internet (United Nations, 2008)

Moreover, from the study of the United Nations between 2004 and 2006 to the economic impact of ICT use in the Thai business and manufacturing sectors as shown in Figure 4.22, there are less widespread in use of computer, web access and web presence in the business sector in Thailand. However, in certain economic sectors firms have more tendencies to use internet and web applications due to the inherent characteristics of the business. In 2006, only 58 per cent of the businesses in the manufacturing sector had access to the internet and only 25 per cent had web presence, while 78 per cent had at least one computer. Since 2004 there has been a relatively positive evolution in the proportion of manufacturing businesses with

computers, Internet access and web presence. Figure 4.23 also indicates that they plan to use it mostly for marketing the products of the business (22 per cent) and as an inquiry and/or contact facility (17 percent). Receiving orders online, communication is still lack of use.

Two important barriers to the use of ICT are the affordability and the lack of skills and trained staff. High expenditure seems to be a barrier of greater importance in terms of the investment policy while training and education in ICT has been put as a main pillar of the national ICT plan. The ICT Surveys find that a large proportion of the firms that do not use ICTs on their premises identify as most important barriers the lack of perceived benefits and ICTs being inappropriate or unnecessary for their business. This finding calls for policy action to raise awareness about the benefits businesses can achieve by using ICTs, especially among small and medium-sized businesses where the proportion of firms refraining from ICT use is higher.

4.7.3 Cycles of Technology, Applications and Knowledge

There is a challenge that should be further analyzed based on the results of Section 4.1 and 4.2. This research focuses on the development of social network web application for industrial cluster communities with the goal of enhancing knowledge sharing and creating new knowledge. To support the idea of the double spiral model that business process cycle and information technology evolves every year, a number of figures are proposed and discussed. This is to ensure that software process must be

customized or maintained regularly to correspond with rapid movements of these two factors.

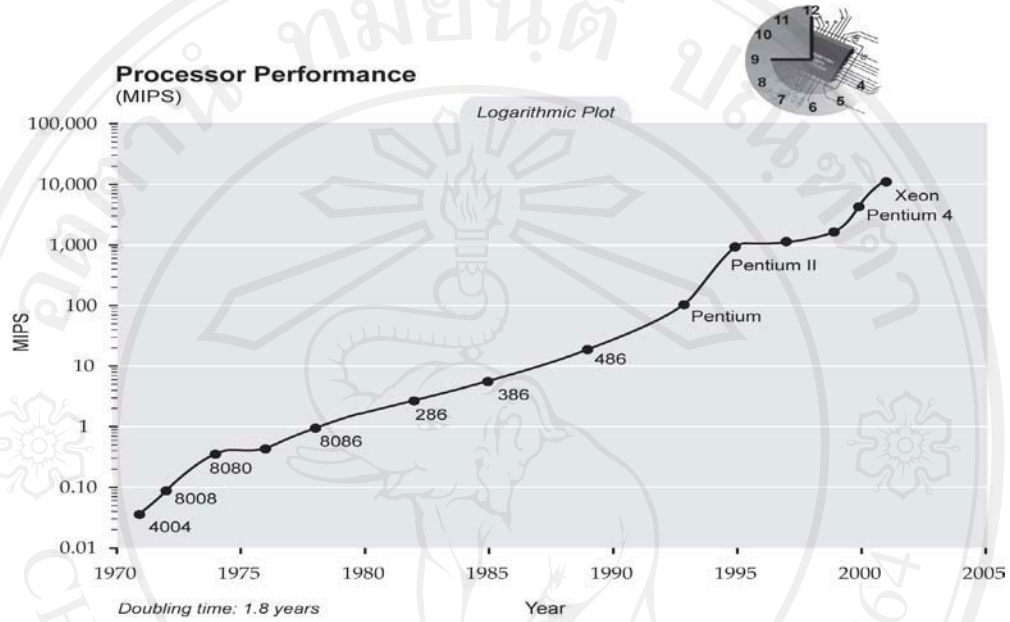

Figure 4.24 Intel processor performance

Figure 4.24 shows that the processor speed is double every 1.8 years. This means that the processing speed of execution of large and complex types of data and information is faster. The communication bandwidth in Figure 4.25 is also double as the process speed in order to carry a large amount of data and information over the internet without the bottleneck. Figure 4.26 also shows that web-based technology tends to change or upgrade every 10 years. However, by focusing on the web tools, they seem to upgrade or launch new tools almost every year. Agassi (2005) insisted that new technology has always been a drive of change and a primary tool to cope with change. In the current market place, company is unavoidable affected by

computing power, network connectivity and functionality provided by richly complex applications.

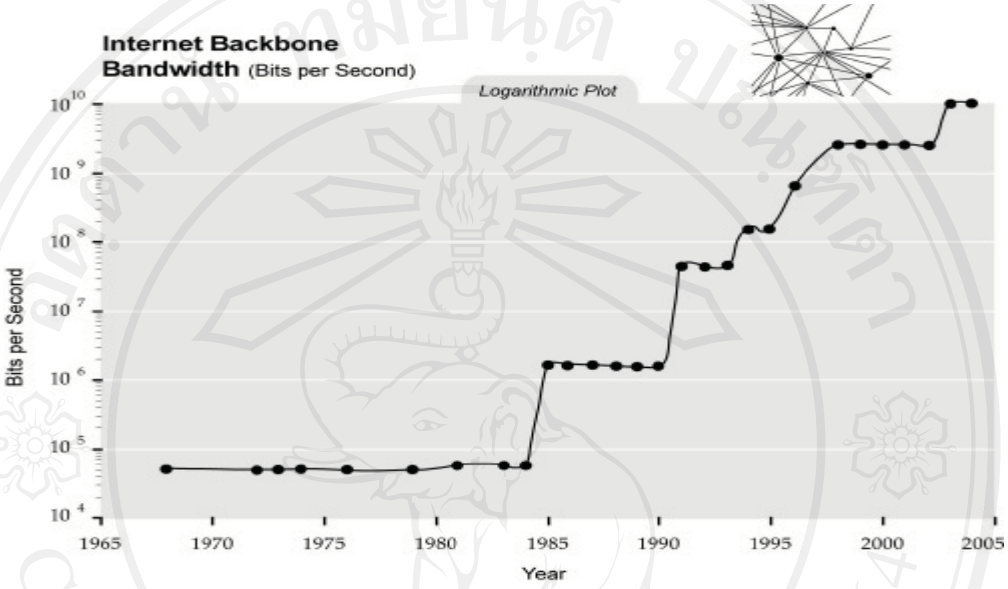

Figure 4.25 Internet backbone bandwidth

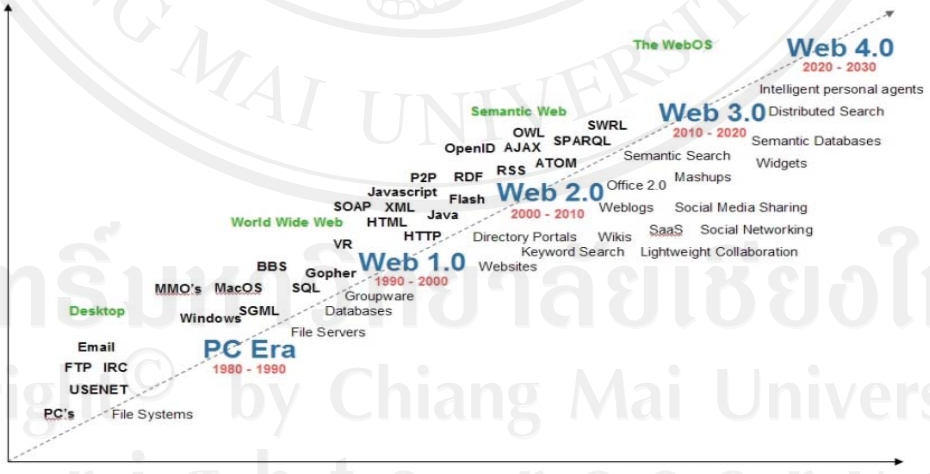

Figure 4.26 The speed of web and the growth amount of data

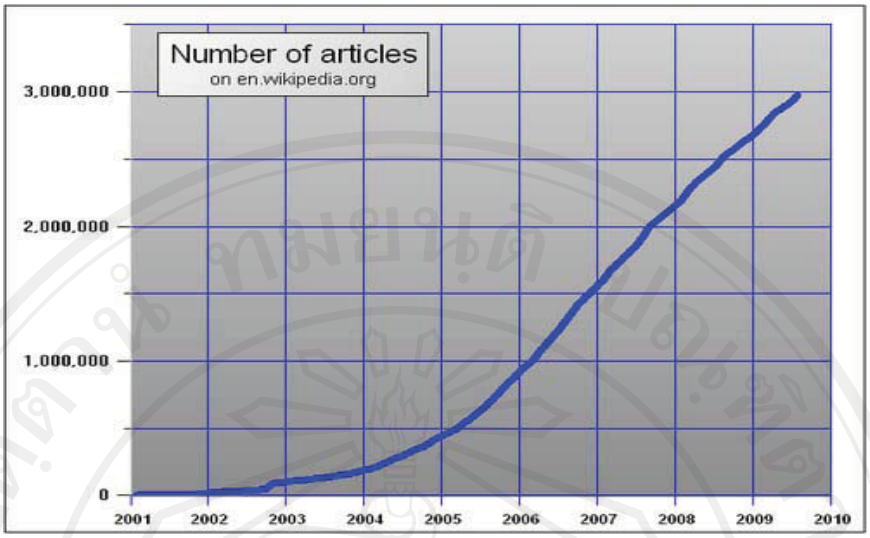

Figure 4.27 Examples of knowledge growth in wikis

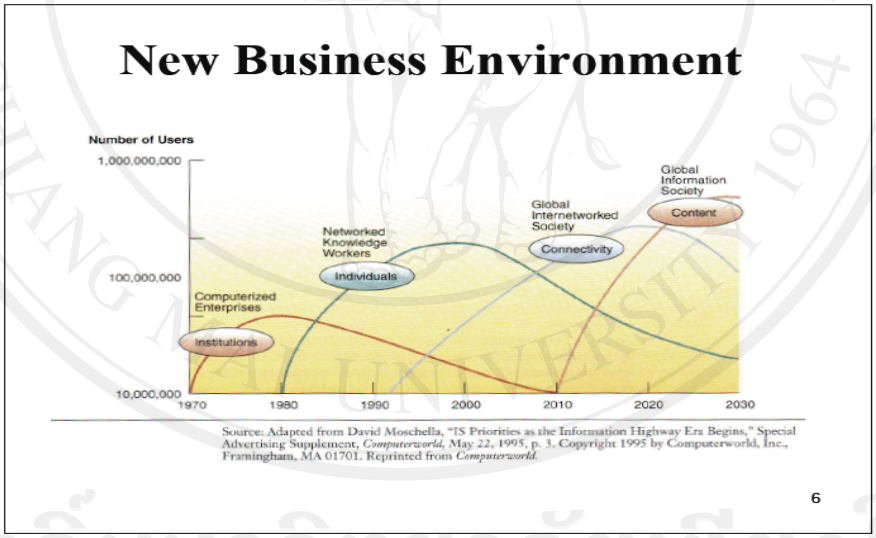

Figure 4.28 Trend of new business environment

In the social network and collaborative-typed applications like industrial cluster, knowledge sharing among members is very important. Figure 4.27 shows that the growth of knowledge in Wikis is double every year. Figure 4.28 also indicates that companies are in the era of moving from connected society to the knowledge content

society. This means that the creation and dissemination of information and knowledge will be critical concerns. Not only the storage technology must be advanced to conform to the high speed of computing and communication but the approach of creating and disseminating information must also be developed.

In summary, there is high tendency of exponential growth in computing and communication technologies, web application tools and new knowledge creation and dissemination. Organizations that adopt or adjust their structure and management quicker than competitors have more chances of success. This means that the concept of real-time enterprise has emerged as the common structure of business solution. Real-time enterprise requires continuous changes and flexibility in reengineering business processes to fit ever changing technologies and market conditions. To become an evolving enterprise companies is therefore technology and organizational process should progress in the same direction so that the speed of knowledge will catch up the speed of technology.

4.8 Conclusion

The experimental result has shown that the prototype of KMS is capable of providing environments for clustering members in collaboration and knowledge sharing through Web 2.0 tools such as e-Mail and social network discussion. However, they prefer to use the push technology like mobile, e-Mail and SMS. Moreover, not all members try to communicate and share knowledge via the web. Therefore, only some groups of clustering members gain benefit from using the

prototype. The experiment is also applied to the real business process in one loop of the double spiral. As double spiral moves to the next cycle, the software content and knowledge content will also be increased.